Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of

Procedures to Govern the Use of Satellite Earth
Stations on Board Vessels in the 5925-6425
MHz/3700-4200 MHz Bands and 14.0-14.5
GHz/11.7-12.2 GHz Bands

IB Docket No. 02-10

ARINC INCORPORATED
PETITION FOR RECONSIDERATION

ARINC Incorporated ("ARINC"), pursuant to Section 1.429 of the Commission's Rules,

47 C.F.R. § 1.429, respectfully seeks limited reconsideration of the Commission's Report and

Order, FCC- 04-286, released January 6, 2005, in this proceeding (the "*ESV Order*"), which

established licensing and service rules for Earth Stations on Vessels ("ESVs") operating in the C-

and Ku-bands.

For the reasons set forth below and in the Technical Appendix attached hereto, ARINC

urges the Commission to remove the requirement of Rule 25.222(a)(6) that all ESV operations in

the Ku-band have "[a] pointing error of less than 0.2°, between the orbital location of the target

satellite and the axis of the main lobe of the ESV antenna"[1] because this requirement is

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[1]   47 C.F.R. § 25.222(a)(6). ARINC is also concerned that adoption of this Rule for
maritime installations not automatically be applied under the markedly different circumstances in
the recently-initiated Aeronautical Mobile Satellite Service ("AMSS") rulemaking. *See In the
Matter of Service Rules and Procedures to Govern the Use of the Aeronautical Mobile Satellite
Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of
Proposed Rulemaking, IB Docket No. 05-20, FCC 05-14 (rel. Feb. 9, 2005) (the "*AMSS
NPRM*").

superfluous in view of the aggregate e.i.r.p. mask adopted by the Commission in the *ESV Order*.[2]

ARINC fully supports the use of an aggregate power mask to control the potential for

interference in this mobile satellite service.

Background

ARINC, the communications company of the air transport industry, has a pending license

application before the Commission for its SKYLink[SM] AMSS system.[3] SKYLink[SM] will provide

aircraft passengers an "office in the sky," featuring uplink speeds between 512 kbps and 3 Mbps

and downlink speeds up to 128 kbps. The SKYLink[SM] system has been in daily operation under

an experimental license since June 2003, and is just one example of an existing and viable

technology that, in addition to its use on aircraft, could satisfy the demands of businesses and

consumers onboard marine vessels. SKYLink[SM]'s unique design allows it to be installed on

corporate aircraft and could also be adapted to operate on personal vessels.

Although ARINC did not participate in the earlier stage of this proceeding, ARINC has

become concerned about the ESV rules because ARINC's SKYLink[SM] system could be deployed

on marine vessels, and because of the possibility that Rule 25.222(a)(6) – and the policy behind

that rule – could potentially be applied by the Commission in the AMSS context. Indeed, it

appears from the *AMSS NPRM* that the Commission has proposed exactly that application.[4]

ARINC's SKYLink[SM] system is fully capable of complying with this Rule, but its

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[2]   Likewise, the removal of Rule 25.222(a)(6) would require, for the very same reasons, the Commission also to remove the related Rule 25.222(a)(7).

[3]   *See* Aeronautical Radio Inc., Application for Blanket Authority to Operate Aboard Aircraft Up To 1000 Technically-Identical Transmit and Receive Mobile Earth Stations in the 11.7-12.2 and 14.0-14.5 GHz Frequency Bands, File Nos. SES-LIC-20030910-01261 & SES-AMD-20031223-01860 (filed Sept. 2, 2003).

[4]   *Compare AMSS NPRM* ¶ 41(i) ("[W]e are proposing that the AES operator should maintain pointing accuracy within 0.2 degrees for all antennas within its licensed network."), *with* 47 C.F.R. § 25.222(a)(6).

implementation could reduce the throughput of the system without any offsetting benefits in terms of reduced potential for interference.

Argument

Rule 25.222(a)(6) requires that Ku-band ESV operators maintain "[a] pointing error of less than 0.2°, between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna."[5] This rule is not only unnecessary and not useful, but it impedes technological advancement. It should therefore be deleted from the Commission's ESV rules and, in all events, not used in any future AMSS rules. As explained in more detail below, this is the only result that is consistent with the Commission's conclusion in the *ESV Order* "that adopting off-axis e.i.r.p.-density rules, as opposed to adopting multiple operating restrictions that accomplish the same objective, is the proper approach to ESV regulation . . . because, in addition to providing simpler service rules, this approach also provides maximum flexibility to ESV operators in implementing the two-degree spacing limits."[6]

1.   ***Specifying Pointing Error Is Unnecessary When Specifying An Aggregate Off-Axis E.I.R.P.*** The 0.2 degree pointing error requirement in Rule 25.222(a)(6) is unnecessary in light of other parts of Rule 25.222 that specify an aggregate off-axis e.i.r.p. Specifically, in Rule 25.222(a)(1)-(4), the Commission has sufficiently defined the maximum permissible power from the ESV at every point in the geostationary arc East or West of the target satellite.[7] Antenna sidelobes and antenna mispointing are fully accounted for in the application of this off-axis e.i.r.p. mask. Because the off-axis e.i.r.p. mask already takes pointing error into account, it is

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5   47 C.F.R. § 25.222(a)(6).

6   *ESV Order* ¶ 14.

7   Technical Appendix at 1.

unnecessary and logically inconsistent to impose antenna pointing requirements in addition to the mask.[8]

Indeed, the Commission itself recognized in this context that the off-axis e.i.r.p. limits alone provide ample protection to adjacent satellite systems. In the *ESV Order*, the Commission "decline[d] to adopt [its] proposal, set forth in the *ESV NPRM*, to require a minimum antenna size for Ku-band ESVs,"[9] and thus "eliminate[d] the need to regulate the specific size of the antenna being used."[10] It based its decision on the sound conclusion "that [the Commission] can provide the same protection to adjacent satellite operators by adopting off-axis e.i.r.p. limits for ESV operations,"[11] noting that it was "satisfied that the off-axis e.i.r.p. limits in [the *ESV Order*] adequately protect adjacent satellite systems and ensure that ESVs do not cause harmful interference to adjacent FSS satellite operators."[12] The same reasoning applies with equal force to Rule 25.222(a)(6). As matter of logic and engineering, it is simply unnecessary to specify a pointing error rule when an off-axis e.i.r.p. limit is also specified, because such an emission limit "adequately protect[s] adjacent satellite systems and ensure[s] that ESVs do not cause harmful interference to adjacent FSS satellite operators."[13]

2. ***The 0.2 Degree Pointing Error Rule Is Not Useful***. Geostationary satellites are spaced 2 degrees apart. Any mispointing of a satellite terminal by 0.2 degrees is likely to have

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[8]   *Id.*

[9]   *ESV Order* ¶ 103.

[10]   *Id.* ¶ 104.

[11]   *Id.*

[12]   *Id.* ¶ 103.

[13]   *Id.*

little or no effect on any other satellite.[14] This is particularly true for very small aperture antennas such as those used in ARINC's SKYLink[SM] system, where required compliance with the off-axis e.i.r.p. mask already results in a significant reduction in the radiated power of the system.[15] Figure 1 in the attached Technical Appendix demonstrates the simulated result of mispointing a Ku-band antenna similar to those ARINC has operated successfully in its SKYLink[SM] system for many thousands of hours without causing interference to other systems.[16] As Figure 1 demonstrates, even when the antenna is mispointed by a full 4 degrees, which is many times the 0.2 degree value in Rule 25.222(a)(6), it does not encroach on the off-axis e.i.r.p. limit.[17]

Thus, by its terms, the aggregate off-axis e.i.r.p. mask permits a limited amount of energy to be radiated off axis, regardless of the pointing error specified in the rule.[18] This simple fact means that any pointing error specification has little, if any, value for protecting adjacent satellites from harmful interference. Put simply, if off-axis emissions do not violate the mask, there is no risk of harmful interference, regardless of the particular pointing error of the antenna.[19]

3. ***The 0.2 Degree Pointing Error Rule Limits Technological Advancement.*** The Commission's rules should permit – indeed, should encourage – innovation and technological

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[14]   Technical Appendix at 1.

[15]   *Id.*

[16]   The SKYLink[SM] system has been in daily operation under an experimental license since June 2003.

[17]   Technical Appendix at 1-2.

[18]   *Id.* at 2.

[19]   *Id.*

advancement. ARINC's SKYLink[SM] system, for example, is based in part on managing and controlling the aggregate off-axis e.i.r.p. of all earth station terminals.[20] Notwithstanding the fact that small aperture antennas used on business aircraft (and potentially small vessels) have a relatively large beamwidth, by limiting each terminal to the minimum power needed to close the link, ARINC will permit more users to have simultaneous access to the system without exceeding the off-axis e.i.r.p. mask. Another, albeit more extreme, approach would be a mobile terminal that employed an omnidirectional antenna with no main lobe.[21] If such an antenna complied with the off-axis e.i.r.p. mask, it would pose no interference problems for adjacent satellite operators. But specifying a pointing error in such a system would have no meaning. At bottom, any pointing accuracy requirement must be a function of both antenna power and beamwidth, and the single most consistent way to deal with these effects is to specify only the aggregate off-axis e.i.r.p.[22]

In short, innovative approaches and technologies can be employed to guard against the potential for harmful interference, and the Commission should incentivize system operators – through "simpler service rules" and "provid[ing] maximum flexibility to ESV operators"[23] – to innovate and develop new approaches and technologies to provide service while at the same time complying with the emissions mask. So long as system operations comply with the off-axis e.i.r.p. limits, adjacent satellite operators will be protected, and the particular methods or technologies used by operators to comply with the mask need not – indeed, should not – be specified. To do so would stifle innovation and new approaches and technologies for providing

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[20]   *Id.*

[21]   *Id.*

[22]   *Id.*

[23]   *ESV Order* ¶ 14.

service. Given the Commission's recognition in the *ESV Order* of the need for "enhanced rights and limited regulation" in the Ku-band,[24] as well as its "goals and objectives for market-driven deployment of broadband technologies,"[25] the Commission should delete Rule 25.222(a)(6). This is the only result that is consistent with Commission's conclusion "that adopting off-axis e.i.r.p.-density rules, as opposed to adopting multiple operating restrictions that accomplish the same objective, is the proper approach to ESV regulation."[26]

Conclusion

For the reasons set forth above, ARINC respectfully requests that the Commission delete Rule 25.222(a)(6) or, at the very least, clarify that the rule – and the policy behind the rule – will not apply to the AMSS rulemaking. All pointing error considerations are fully taken into account through the specification of the mask for aggregate off-axis e.i.r.p. density. No additional restrictions, limitations or specifications are necessary.

Respectfully submitted,

ARINC INCORPORATED

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March 2, 2005

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[24]   *Id.* ¶ 2.

[25]   *Id.* ¶ 4.

[26]   *Id.* ¶ 14.

TECHNICAL APPENDIX

This technical appendix provides an engineering analysis to support the Petition for Reconsideration filed by ARINC Incorporated ("ARINC") in connection with the Commission's establishment of licensing and service rules for Earth Stations on Vessels ("ESVs").[1] In particular, ARINC submits that Rule 25.222(a)(6) – which requires that all ESV licensees and operations in the Ku-band have "[a] pointing error of less than 0.2°, between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna"[2] – should be repealed for the reasons set forth below. For the same reasons, the Commission should either delete the rule or clarify that the policy behind the rule will not apply to the recently initiated Aeronautical Mobile Satellite Service ("AMSS") rulemaking.[3]

1. ***Specifying Pointing Error Is Unnecessary When Specifying An Aggregate Off-Axis E.I.R.P.*** The 0.2° pointing error requirement in Rule 25.222(a)(6) is unnecessary since other parts of Rule 25.222 specify an aggregate off-axis e.i.r.p. The aggregate off-axis e.i.r.p. mask set forth in Rule 25.222(a)(1)-(4) sufficiently defines the maximum permissible power at every point in the geostationary arc East or West of the target satellite. Antenna sidelobes and antenna mispointing are fully accounted for in the application of the off-axis e.i.r.p. mask. Because the off-axis e.i.r.p. mask already takes pointing error into account, it is unnecessary and logically inconsistent to impose antenna pointing requirements in addition to the mask.

2. ***The 0.2• Pointing Error Rule Is Not Useful***. Geostationary satellites are spaced 2° apart in the sky. Mispointing by 0.2° is likely to have little or no effect on any other satellite. This is particularly true for very small aperture antennas such as those used in ARINC's SKYLink[SM] system, where required compliance with the mask already results in significant backoff in the radiated power[4]. Figure 1 below demonstrates the simulated result of mispointing a Ku-band antenna similar to those SKYLink[SM] has operated successfully for many thousands of hours without interference to other systems.[5] The upper bound shown in the figure is 1 dB less than the aggregate off-axis e.i.r.p. limit set forth in Rule 25.222. Even when mispointed by 4°

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[1] *See generally In the Matter of Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 Bands and 14.0-14.5 GHz/11.7-12.2GHz Bands*, Report and Order, IB Docket No. 02-10, FCC 04-286 (rel. Jan. 6, 2005) (the "*ESV Order*").

[2] 47 C.F.R. § 25.222(a)(6).

[3] *See In the Matter of Service Rules and Procedures to Govern the Use of the Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed Rulemaking, IB Docket No. 05-20, FCC 05-14 (rel. Feb. 9, 2005) (the "*AMSS NPRM*").

[4] ARINC has a pending license application before the Commission for its SKYLink[SM] Aeronautical Mobile Satellite Service ("AMSS") system. The SKYLink[SM] system is one example of an existing and viable technology that could satisfy the requirements of maritime vessels.

[5] The SKYLink[SM] system has been in daily operation under an experimental license since June 2003.

(many times the 0.2° value in Rule 25.222(a)(6)), the terminal does not encroach on the off-axis E.I.R.P limit. Thus, regardless of the pointing error specified, the aggregate off-axis e.i.r.p. mask permits a limited amount of energy to be radiated off axis. This simple fact means that any pointing error specification has little, if any, value for protecting adjacent satellites from harmful interference. Stated differently, if emissions do not violate the mask, there is no risk of harmful interference, regardless of the particular pointing error of the antenna.
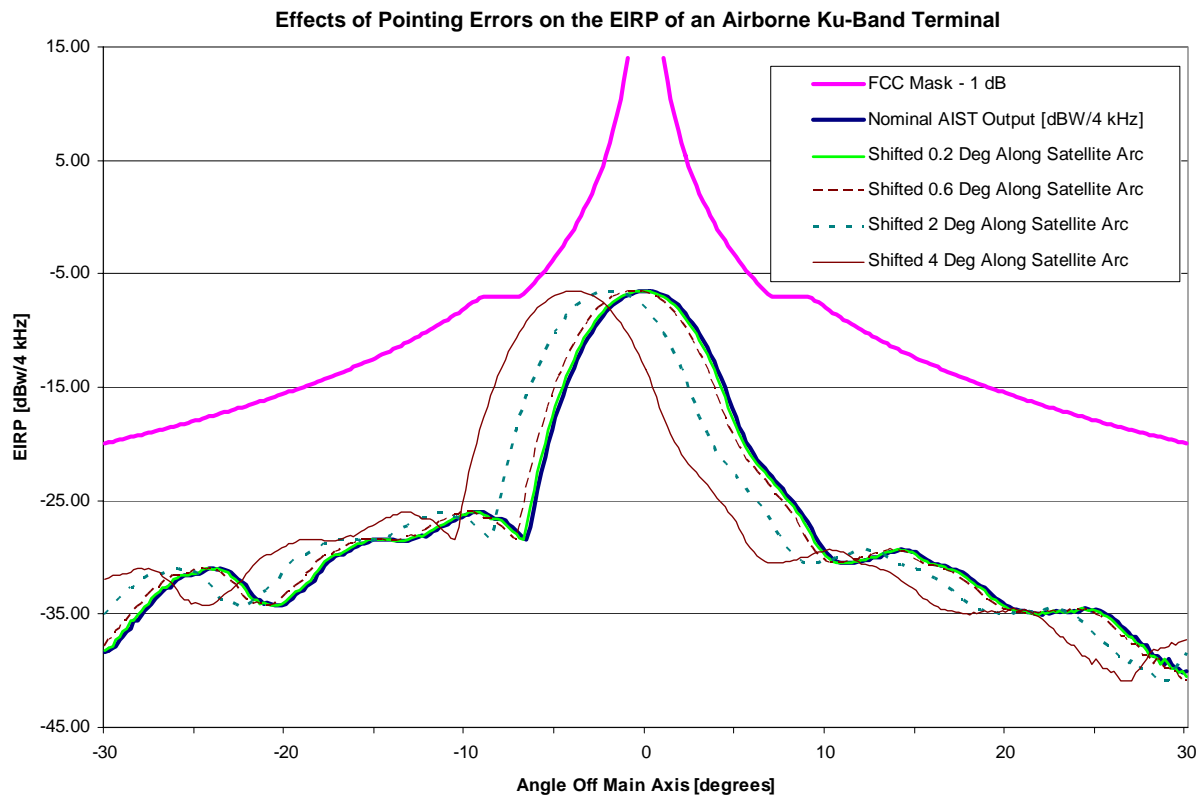

Effects of Pointing Errors on the EIRP of an Airborne Ku-Band Terminal

Legend:
- FCC Mask - 1 dB
- Nominal AIST Output [dBW/4 kHz]
- Shifted 0.2 Deg Along Satellite Arc
- Shifted 0.6 Deg Along Satellite Arc
- Shifted 2 Deg Along Satellite Arc
- Shifted 4 Deg Along Satellite Arc

Y-axis: EIRP [dBW/4 kHz]
X-axis: Angle Off Main Axis [degrees]

Figure 1. Effects of Mispointing in Low Power Antennas

3. *The 0.2° Pointing Error Rule Limits Technological Advancement*. The Commission's rules should permit – or even encourage – innovation and advancement in technology. ARINC's SKYLink[SM] system, for example, is based in part on managing and controlling the aggregate off-axis e.i.r.p. of all earth station terminals. The small aperture antennas used on airborne vessels may have a relatively large beamwidth. By limiting each terminal to the minimum power needed to close the link, as conceptualized in Figure 1 above, more users can be permitted simultaneous access to the system without exceeding the off-axis e.i.r.p. mask. A more extreme example would be a mobile terminal that has an omnidirectional antenna with no main lobe. Specifying a pointing error in such a system would have no meaning. Clearly any pointing accuracy requirement must be a function of both antenna power and beamwidth, and the single most consistent way to deal with these effects is to simply specify the aggregate off-axis e.i.r.p.

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       In light of the above considerations, ARINC recommends that the Commission repeal Rule 25.222(a)(6) and simply account for all pointing error considerations through the specification of the mask for aggregate off-axis e.i.r.p. density. Variations in the antenna pattern of AESs and variations in the transmit E.I.R.P power from any and all AESs are fully accounted for in the off-axis e.i.r.p. mask and no additional restrictions, limitations or specifications are necessary.

CERTIFICATION OF PERSON RESPONSIBLE
FOR TECHNICAL INFORMATION

I am the Manager of the SKYLink^{SM} program at ARINC Incorporated. I certify that I am qualified to review the technical information contained in this ARINC Incorporated Petition for Reconsideration, that I am familiar with Part 25 of the Commission's Rules, that I have prepared and/or reviewed the technical information submitted in this document, and that it is complete and accurate to the best of my knowledge.

My technical qualifications include over 30 years of direct experience in communications and systems engineering. I hold a B.S. in Electrical Engineering from the Virginia Military Institute and an M.S. in Computer Science from The Johns Hopkins University.
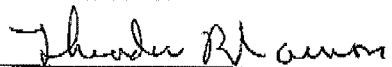
By: _William M. Kolb_

William M. Kolb
Project Manager, SKYLink^{SM} Program
ARINC Incorporated

Dated: March 2, 2005

Sworn and subscribed to before me this 2nd day of March 2005.

Theodore Bd Gammon

Notary Public

My Commission Expires: 5 - 1 - 2006